AUTOMATED EVALUATION SYSTEM OF STRESS IN CATTLE

By

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CERTIFICATE OF ORIGINAL AUTHORSHIP

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis. This research is supported by the Australian Government Research Training Program.

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ABSTRACT

Stress in animals can be defined as internal and external body response to environmental effects. Stressed cattle after slaughtering produce meat with less than the normal amount of glycogen with undesirable taste and colour, which is called 'dark meat'. Dark meat is not appropriate for human consumption which causes massive economic losses in the global meat industry. Cattle under stress exhibit high metabolic rate, heart rate, respiration rate, and skin temperature. These physiological changes have been used in many studies as stress indicators for measuring stress in cattle before slaughtering such as blood tests and rectal temperature. These current measurement methods are invasive and are considered as wasting time and effort when dealing with a very large number of cattle on a farm. Several researchers used Infrared thermography technology (IRT) as an alternative non-invasive method for detecting stress pre-slaughtering through measuring temperature for eyes region. So far little research has been carried out to detect pre-slaughter stress automatically in cattle with dark-meat prediction. Therefore, the main aim of this research is to develop a new fully automated system for detecting stress pre-slaughtering and predicting dark meat.

Multi-view face detection in cattle with enhancement of the accuracy of detection rate. Multi-view face detection is achieved through using three Support Vector Machine (SVM) classifiers, which are established by using Histogram Oriented Gradient (HOG) as features and SVM for classification. Detected face is used as the Area of Interest for eyes segmentation.

A novel segmentation approach to automatically identify the eyes of cattle regardless of the position of the animal in relation to the camera. This proposed novel method includes foreground identification using edge difference. A new method for thresholding based on histogram processing is also proposed. After eye segmentation, eye localization and temperature measurement will be the last stage of the proposed method.

Lastly, Support Vector Machine (SVM), Logistic Regression (LR), Naïve Bayes (NB), Decision Tree (DT) are developed as machine learning algorithms for stress assessment and predicting dark-cutting. The results show that the proposed system based on the Decision Tree model can be used to detect stress with a dark-meat prediction with significant accuracy in term of Specificity, Recall and F-measure.

DEDICATION

To who gave me endless love support and encouragement my parents: ***Ahmed Jaddoa and Saadiyah Ismael***

Also, To my beloved supervisor: ***Assoc.Prof. Adel Al-Jumaily***

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THESIS ACRONYMS

AI	Artificial Intelligence
ANN	Artificial Neural Network
e-Health	Electronic Healthcare
F1	F1 Score
FN	False Negative
FP	False Positive
IRT	Information Technology
IT	Infrared Thermography Technique
KNN	k-nearest Neighbours Algorithm
LNN	Linear Neural Network
ML	Machine Learning
MLP	Multi-Layer Perceptron
RL	Receiver Operator Curve
ROC	Reinforcement Learning
SVM	Support Vector Machine
TN	True Negative
TP	True Positive
VSM	Vital Signs Monitor
WSN	wireless sensor networking

LIST OF PUBLICATIONS

Journal Paper (Under review):

M. A. Jaddoa, A. Al-Jumaily, L. Gonzalez and H. Cuthbertson, “Novel automatic eyes segmentation in cattle based on intensity features and edge processing using infrared thermography images”. URL: https://link.springer.com/journal/11042 Paper Submission: 16 April 2019

Conference Paper:

M. A. Jaddoa, *A.* Al-Jumaily, L. Gonzalez and H. Cuthbertson, "Automatic eyes localization in thermal images for temperature measurement in cattle”, 12th International Conference on Intelligent Systems and Knowledge Engineering URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8258765&isnumber=8258711.

Jaddoa, M.; Al-Jumaily, A.; Gonzalez, L. and Cuthbertson, H. (2019). Automatic Temperature Measurement for Hot Spots in Face Region of Cattle using Infrared Thermography. In Proceedings of the 16th International Conference on Informatics in Control, Automation and Robotics - Volume 1: ICINCO, ISBN 978-989-758-380-3, pages 196-201. DOI:10.5220/0007810101960201,URL:https://www.scitepress.org/PublicationsDetail.aspx?ID=s1eU9W7jntE%3d&t=1.

Book Chapter:

M. A. Jaddoa, Cuthbertson H, Al-Jumaily A. Multi View Face Detection in Cattle Using Infrared Thermography. In Applied Computing to Support Industry: Innovation and Technology: First International Conference, ACRIT 2019, Ramadi, Iraq, September 15–16, 2019, Revised Selected Papers 2020 Jan 7 (Vol. 1174, p. 223). Springer Nature